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The Sixteenth International Conference on the Physics of Electronic and Atomic Collisions was held in New York City, 26 July - 1 August 1989, with an attendance of 800 people. Topics covered included Photons, Electron-Atom Collisions, Electron-Molecule Collisions, Electron-Ion Collisions, Collisions Involving Exotic Species, Ion-Atom Collisions, Ion-Molecule or Atom-Molecule Collisions, Atom-Atom Collisions, Ion-Ion Collisions, Collisions Involving Ryberg Atoms, Field Assisted Collisions, Collisions Involving Clusters, Collisions Involving Condensed Matter, Experimental Techniques, and Related Topics.

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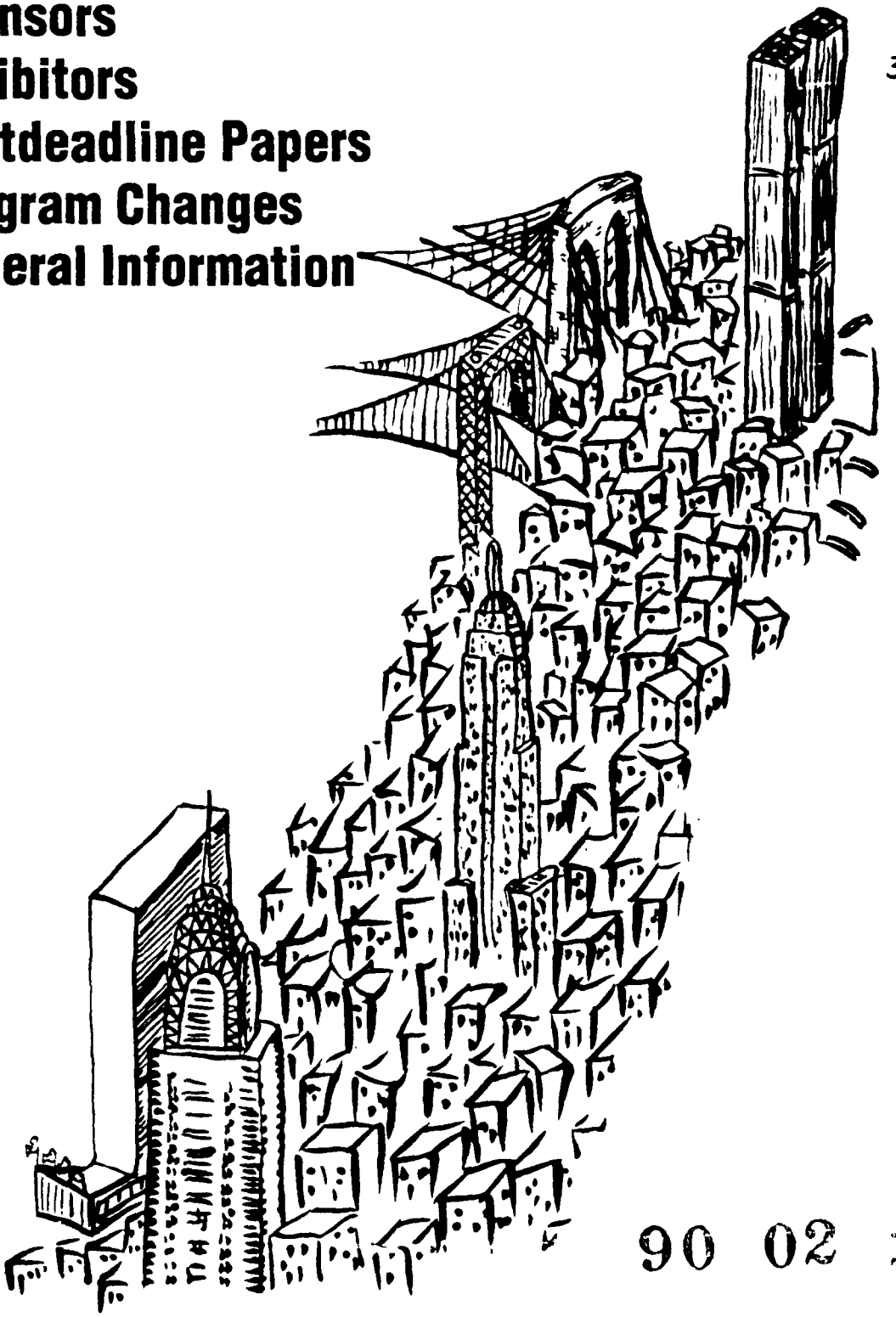
Sixteenth International Conference on the Physics of Electronic and Atomic Collisions

XVI ICPEAC

30th Anniversary

Sponsors
Exhibitors
Postdeadline Papers
Program Changes
General Information



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XVI ICPEAC
July 26 - August 1, 1989

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16th International Conference on the Physics of Electronic and Atomic Collisions
Grand Hyatt Hotel, New York, New York, U. S. A.
July 26-27, 1989

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GENERAL INFORMATION

GENERAL INFORMATION

16th INTERNATIONAL CONFERENCE ON THE PHYSICS OF ELECTRONIC AND ATOMIC COLLISIONS
JULY 26 - AUGUST 1, 1989

WELCOME!

The staff at the Conference Desk will be pleased to assist you. Hostesses at the Registration and Information Desks speak five languages -- English, French, German, Russian, and Spanish.

Welcome Reception: A Welcome Reception will provide an opportunity for greeting old friends and meeting new ones on Tuesday, July 25, from 5:30 to 6:30 p.m., in Ballroom C of the Grand Hyatt Hotel, adjacent to the ICPEAC Registration Area. Wine, beer, soft drinks and light *hors d'oeuvres* will be served.

Meeting Place: The Booth/Imperial Room, on the Conference Room level of the hotel, will serve as a Meeting Place, available throughout the Conference. All activities for the Accompanying Persons' Program will take place here, and this will be the starting point for all tours. The room will be open from 8 a.m. to 10 p.m. each day, including Saturday and Sunday.

Bederson Award Book: A book citing Ben Bederson's contributions to ICPEAC, atomic physics, and scientific publishing will be available for a signature gathering at the ticket exchange table until noon on Thursday, July 27, and at the main Registration Desk thereafter. The book, produced by Academic Press, will be presented to Ben at the Awards Session on Tuesday, August 1, at 9:45 a.m.

Messages: Please check the message boards, located near the Information Desk in Ballroom Foyer FREQUENTLY. Messages will be placed in alphabetically-marked sections of the bulletin boards. The telephone numbers for connecting with the message center are 212/ 883-1234, ext. 3603 and 3604.

FAX Facilities: If you need to have material sent to you by Facsimile machine, you should have it sent to you, in care of XVI ICPEAC, to the FAX machine at the concierge desk in the hotel lobby. The number is 212/697-3772.

BITNET Facilities: Electronic mail facilities will be available starting Thursday, July 27 in the Majestic Room at the hours posted on the door. You may receive mail at the following BITNET address: MIACC @ CUNYVM. If you wish electronic mail from the terminal in the Majestic Room, the dial-up number for the CUNY node is 974-8600. The log-on ID is MIACC, and the password is "Tuesday."

XVI ICPEAC Posters: XVI ICPEAC Posters will be available for sale in the Registration Area beginning on Thursday morning. The cost is $6 each.

Accompanying Persons' Program: The accompanying persons' program contains many tours and visits outlined in the third announcement. To begin the week, there will be a general orientation on sightseeing in New York City, with a service of coffee and pastries, in the Booth/Imperial Room at 9 a.m. on Wednesday, July 26. A representative of the New York Convention and Visitors Bureau will be there to answer questions and distribute special sightseeing information. Informal walking tours of New York City will be arranged, and visitors may sign-up for general sightseeing tours. On Monday, July 31, Professor David Markowitz will speak on "What are They Doing When They're Not at Home?" The talk, scheduled for 9:30 a.m. in the Booth/Imperial Room, will provide a look at what's important in physics today for spouses of physicists.

PROGRAM CHANGES

PROGRAM CHANGES

Plenary Lecture

As a result of unexpected circumstances, Professor Y. T. Lee is unable to deliver the previously announced Plenary Lecture for 13:00 on Friday. We are grateful to Professor D. M. Neumark of the Chemistry Department of the University of California at Berkeley for agreeing at a late date to deliver a Plenary Lecture entittled "Spectroscopy of Transition States of Hydrogen Transfer," which will include results of collaborative work with Professor Lee.

Poster Sessions

• The Poster "Orientation of p-States in Ion-Atom Collision Propensity Rules for Excitation and Capture" by S. E. Nielsen, J. P. Hansen and A. Dubois will be presented twice: at the scheduled time on Friday (Fri 157) and in Tuesday's session on **Ion-Atom Collisions** as Poster (Tue 114).

• The Poster "Dissociation of Hydrogen Molecules in H_2-Ar Discharge" (Mon 13) by M. A. Islam, has been withdrawn.

• The Poster "Bremsstrahlung of Electrons Scattered by Xenon Atoms" (Thu 64) by E. T. Verkhovtseva, listed as "abstract withdrawn" has been resubmitted. It is reproduced here as the first abstract and will be presented in the originally scheduled session (Thu 64).

• Post-deadline Contributions: The book of Abstracts contains 31 post deadline contributions. These, along with the eight contributions reproduced in this booklet, will be presented in the **Post Deadline Session** on Tuesday afternoon.

POST-DEADLINE ABSTRACTS

BREMSSTRAHLUNG OF ELECTRONS SCATTERED BY XENON ATOMS

E.T. Verkhovtseva, E.V. Gnatchenko, and A.A. Tkachenko

Institute for Low Temperature Physics and Engineering,
UkrSSR Academy of Sciences, 310164, Kharkov, USSR

Modern theoretical concepts [1] suggest that the bremsstrahlung (BS) spectrum of electrons scattered by atoms is generated by two mechanisms. The first mechanism is radiation of photons by an incoming electron when braking in a static atomic field, i.e. "electron" BS, and the second one is radiation by an atom due to its dynamic polarization by the incoming electron field, i.e. "polarization" BS.

The polarization BS was first observed in purposive experiments with 0.6 keV electron scattering by Xe atoms in the region of 4d threshold [2]. This paper deals with the BS dependences on the energy of electrons scattered by xenon atoms.

The experiments were carried out by using a setup comprising an X-ray tube with a supersonic gas jet as an anode and a grazing-incidence spectrometer RSM-500. The angle between the direction of the incoming electrons and that of the photons examined was 97°. The experimental technique and procedure are given in detail in [3]. The figure shows total BS spectra taken with 0.3, 0.6 and 0.9 keV electron scattering by Xe atoms. Analysis of the spectra permits us to ascertain that: 1) as the electron energy in increased from 0.3 to 0.9 keV, the BS curve shifts to smaller photon energies, i.e. the experimental BS maximum approaches both the resonance in the photoabsorption spectrum and the maximum of the theoretical BS curve calculated in the logarithmic approximation;[1] 2) as the electron energy is increased the spectrum profile is modified: the band on a smaller photon energy side becomes more asymmetric. Moreover, for the electron energies of 0.3 and 0.6 keV, the BS spectra display a branch in the photon energy range above 145 eV due to virtual excitations of Xe atoms into an ionization continuum above the 4p threshold.

Based on the modern theoretical concepts, the analysis of the results permits us to suggest that the BS curve profile and the maximum position are affected both by the interference of the "electron" and "polarization" BS and the transferred momentum dependence of atomic polarizability in the scattering process. This suggestion is supported by the theoretical calculations made in the Born approximation with taking the above dependence and interference into account.

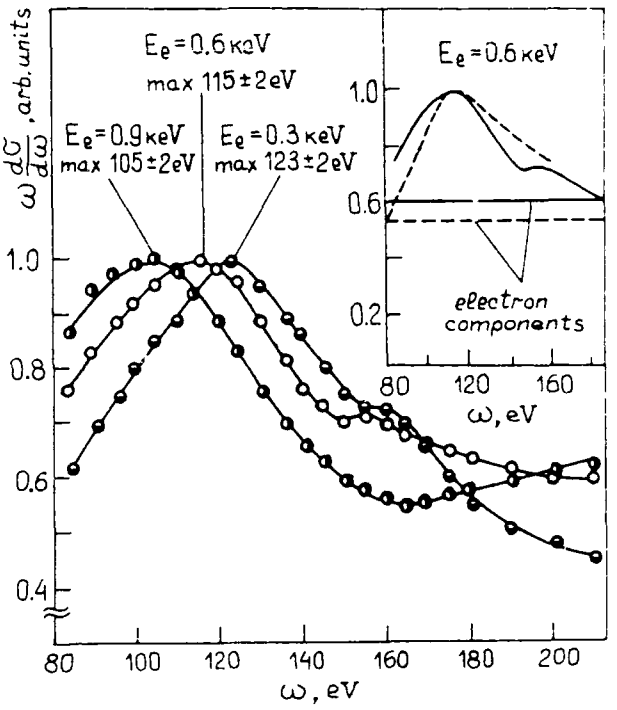

Figure 1. BS spectra of electrons on Xe atoms. Inset: comparison of the experimental BS spectrum (——) and the theoretical one [1] (- - -)

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3. E.T. Verkhovtseva et al., J. Phys. B19 2089 (1986).

THE $Cs(7P) + H_2 \rightarrow CsH + H$ REACTIVE COLLISION : ROTATIONALLY-RESOLVED CROSS SECTIONS

Jean-Marc L'Hermite, Gabriel Rahmat and Raymond Vetter

Laboratoire Aimé Cotton, Bât. 505, 91405 Orsay cedex, France

The $Cs(7P_{1/2}) + H_2 \rightarrow CsH(v''=0, J'') + H$ photochemical reaction at thermal energies is studied in a crossed-beam experiment, with laser-induced fluorescence detection of CsH products [1,2]. A supersonic beam of H_2 and an effusive beam of Cs atoms cross at right angle; two single mode tunable laser beams intersect the collision volume, the first one is locked on a given $6S \rightarrow 7P$ hyperfine transition of cesium and the second one is scanned over a definite $X^1\Sigma^+(v''=0, J''<17) \rightarrow A^1\Sigma^+(v'=5, J')$ transition of CsH molecules. Figure 1 shows a recorded fluorescence profile for J"=11, at 0.09 eV collision energy, when the analysis laser beam propagates along the collision axis: its shape yields the differential cross section , and its area the total cross section.

The rotational distribution of products at 0.09 eV collision energy is pointed on figure 2: the 17 first rotational levels only are populated in v"=0, as expected from the energy balance of this isoenergetic reaction. Figure 3 shows the total cross section relative to J"=6 as function of the collision energy that we varied by heating or cooling the hydrogen beam nozzle and by seeding hydrogen in helium; its variation agrees with calculations of the reaction dynamics involving spin-orbit couplings at 8 -11 a.u.internuclear distance between the incoming covalent channels and the ionic Cs^+-H_2^- intermediate[3]. As expected from calculations of potential energy surfaces[4],there is no barrier higher than 0.015 eV in the $Cs(7P_{1/2}) + H_2$ entrance channel.

High resolution scanning of fluorescence Doppler profiles using two different arrangements of the analysis laser beam (parallel and perpendicular to the collision axis) leads to rotationally-resolved differential cross sections. The angular analysis is possible because the velocity of products is the same for a given J" value . In spite of a good spectral resolution of 30 MHz F.W.M.H., the angular resolution is 25° only in the example of figure 1, where the velocity of CsH products in the center of mass is 22 m / s , and the corresponding full Doppler width 70 MHz; the fluorescence Doppler profile peaks toward the red, indicating a pronounced "forward" scattering of CsH products ; this result is consistent with the harpooning process .The angular scattering probability is drawn on figure 4 for different energies : "forward" scattering increases with collision energy but does not vary much with J"

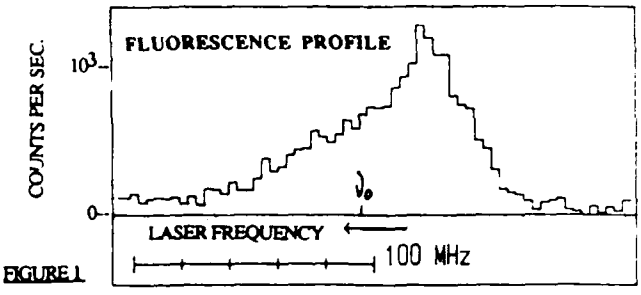

FIGURE 1

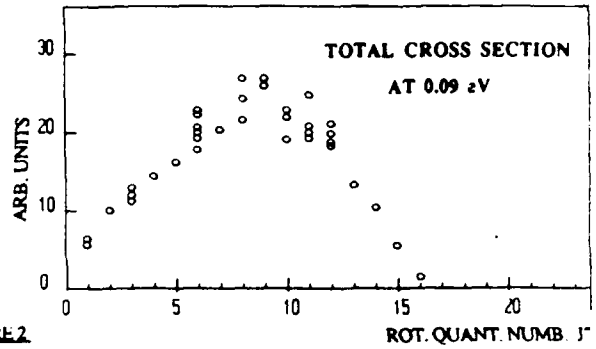

FIGURE 2

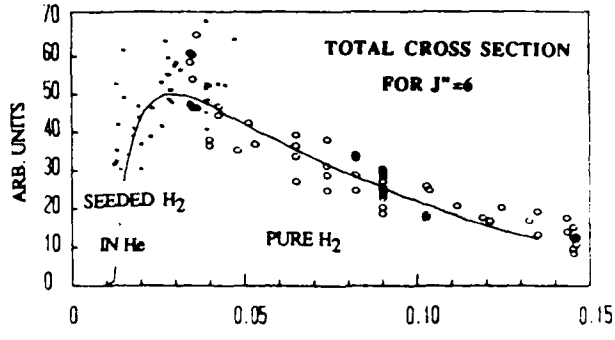

FIGURE 3

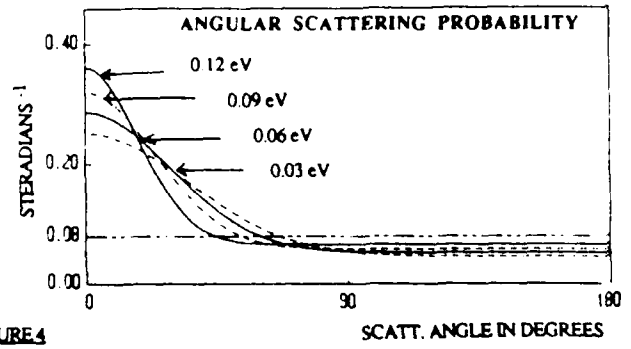

FIGURE 4

References

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EXPERIMENTAL AND THEORETICAL ANALYSIS OF COLLECTIVE EFFECTS IN ELECTRON IMPACT IONIZATION PHENOMENA

G.Arena, M.Armenante, R.Bruzzese, F.Giammanco*, N.Spinelli, R.Velotta

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*Dipartimento di Fisica, Universita' di Pisa, Pisa, Italy

The importance of collective effects, depending on the electron-ion mutual interaction, in experiments involving the production and collection of charged particles has been investigated. Although many authors concerned with different fields of investigations and applications introduced the so called "space-charge" effect as a possible explanation of the observed "anomalous" dependences on the laser power, nevertheless, no experimental work was especially performed to carry out a detailed analysis of the collective plasma phenomena and their range of influence. We report the observation of relevant collective effects in the process of electron impact ionization of low density atomic and molecular gases (pressure 10^{-6}: 10^{-4} Torr). It has been observed a focussing ion effect on the electronic beam very similar to that observed in a different experimental condition in which, anyway, collective effects were present.

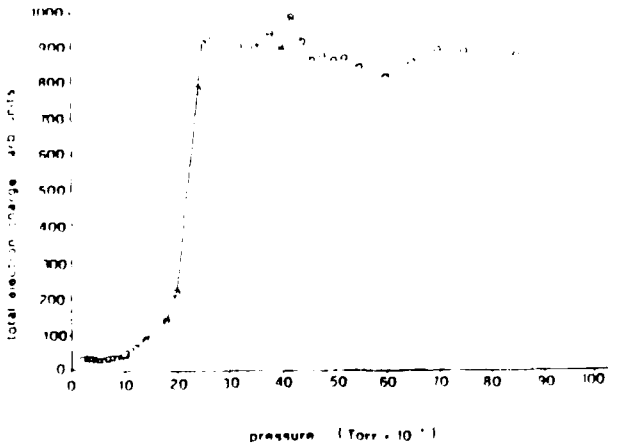

Figure 1. Total collected charge of the electron beam pulse as a function of the gas pressure.

The focussing effect results, in the present case, in an increase of the axial current measured by an electron detector, whose radius is smaller than the radial width of the unperturbed electron beam, which monitors the electron beam current after it has passed through the target gas.
The observed effect shows a strong dependence on the gas pressure, i.e. on the degree of ionization produced. Actually, the peak and the total charge of the electron current exhibit a sudden growth in a very small range of pressure variation and subsequently the behavior is quite flat, except for a non-regular modulation.
The total ion count rate exhibits a change in the slope in corrispondence of the same range of pressure.

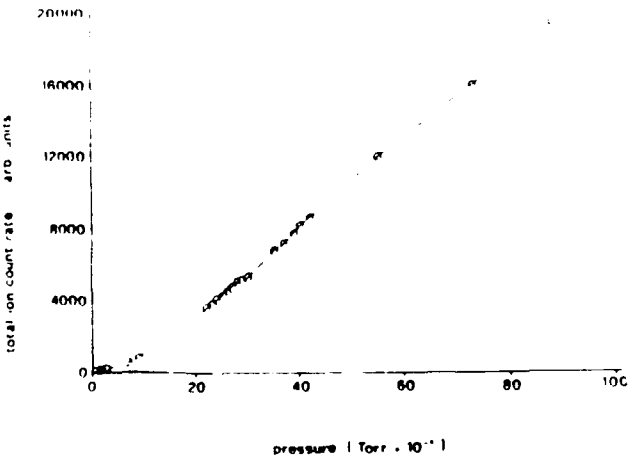

Figure 2. Total ion count rate as a function of the gas pressure.

Moreover, the shape of the peaks in the time of flight (TOF) spectrum of the produced ions changes as a function of the gas pressure, showing a growing tail in the region of increasing time of flight.
By adapting the theoretical approach described in ref.1 in order to include the specific features of the experiment, an analysis of the phenomena has been carried out, as well as a detailed comparison with the experimental results.

References

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RESONANCES IN LOW-ENERGY ELECTRON-MOLECULE COLLISIONS

W. M. Huo,* C. A. Weatherford,† and T. L. Gibson,‡

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‡Dept. of Physics, Texas Tech Univerisity, Lubbock, TX 79409 USA

In a series of studies on low-energy electron-molecule collisions, we have found rich resonance structures in both elastic and inelastic channels. The calculations were carried out using a multichannel Schwinger variational principle,[1] and included both diatomic and polyatomic targets. The resonances were analyzed by studying the partial wave T-matrix (or K-matrix) elements.

Resonances in the valence excitations in N_2 have been studied[2,3] using a six-state calculation including $X^1\Sigma_g^+$, $A^3\Sigma_u^+$, $B^3\Pi_g$, $W^3\Delta_u$, $B'^3\Sigma_u^-$, and $C^3\Pi_u$, and a five-state calculation including $X^1\Sigma_g^+$, $a^1\Pi_g$, $a'^1\Sigma_u^-$, $w^1\Delta_u$, and $B^3\Pi_g$. We observed both core excited valence-type and Rydberg-type shape resonances. The nature of the negative ion responsible for the resonance was deduced by comparing the phase of the partial wave T-matrix elements for the inelastic channel as well as the elastic channels of the initial and final target states. The positions of the calculated resonances for the X - $B^3\Pi_g$, X - $A^3\Sigma_u^+$, and X - $a^1\Pi_g$ transitions are in agreement with the experimental measurements of Mazeau et al.,[4] Sanche and Schulz,[5] and Polley and Bailey.[6] In addition, resonance structures also appear in excited state to excited state inelastic cross sections. Their positions can be correlated with the same negative ion states found in ground to excited transitions.

We also studied resonances in Rydberg excitions in CO, $X^1\Sigma^+ \rightarrow b^3\Sigma^+$, and in N_2, $X^1\Sigma_g^+ \rightarrow E^3\Sigma_g^+$, at the two-state level.[7,8] Both transitions show core-excited Rydberg-type shape resonances near threshold, in agreement with experiment.[9,10] The positions of these resonances are sensitive to the treatment of differential correlation effects between the negative ion and the neutral molecule. The analysis of eigenphases indicates that both time-delayed and time-advanced scattering contribute at resonance. The time-advanced character is due to interference effects between resonant and nonresonant contributions.[8]

Resonance structures have also been found in the elastic scattering of the series of fluoromethanes CF_4,[11] CHF_3, CH_2F_2, and CHF_3. These calculations were carried out at the static-exchange level. Correlated treatment for CF_4 is in progress.

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Broadening and Shifts of Ca Rydberg States

K.S. Bhatia and Y. Makdisi,

Physics Department, Kuwait University.

ABSTRACT

Impact broadening of Calcium Rydberg States has been studied by two photon excitation using a tunable dye laser pumped by an excimer laser. The atoms in a heat pipe were prepared in the ns ^1S_o and nd $^1D_2$ states and the pressure broadening of these states over a wide range of pressures of the inert perturber gases He, Ar and Xe were measured.

Pressure dependence of broadening and shift parameters of the even parity Rydberg states will be discussed. Interconfiguration perturbations and observation of new series due to doubly excited terms of Ca will be presented. Possible origin of the new lines due to two photon-one collision interaction and two photon-two collision interactions will be outlined.